



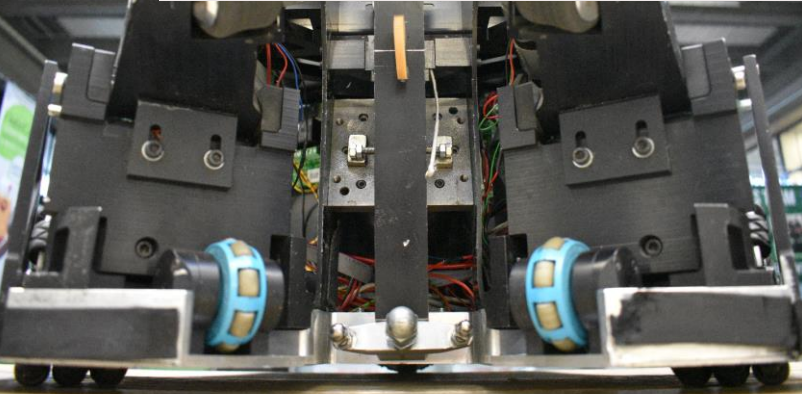
# Towards Digital Twins for soccer robots: a use case in reusing artifacts

Demo at ModDiT 2021 @MODELS workshop, October 12<sup>th</sup> 2021, Online

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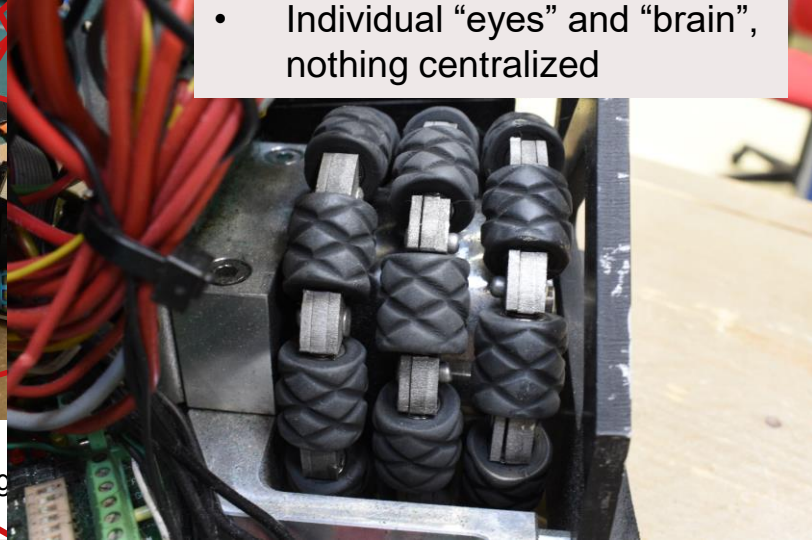


# Robot soccer at TU/e—Middle size league (MSL)



General rules and restrictions:

- Inspired by FIFA regulations
- 1 goalie + 4 players
- Individual “eyes” and “brain”, nothing centralized



# Digital Twin for soccer robots

Digital Twin could be used to:

- understand hardware and software
- analyze performance
- test changes
- apply new techniques e.g. ML

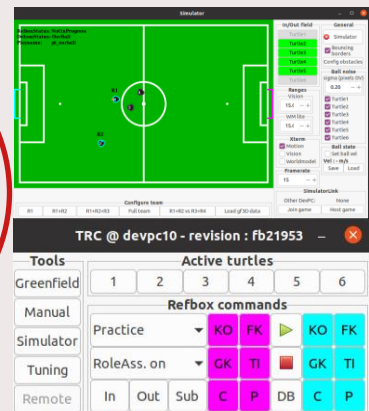
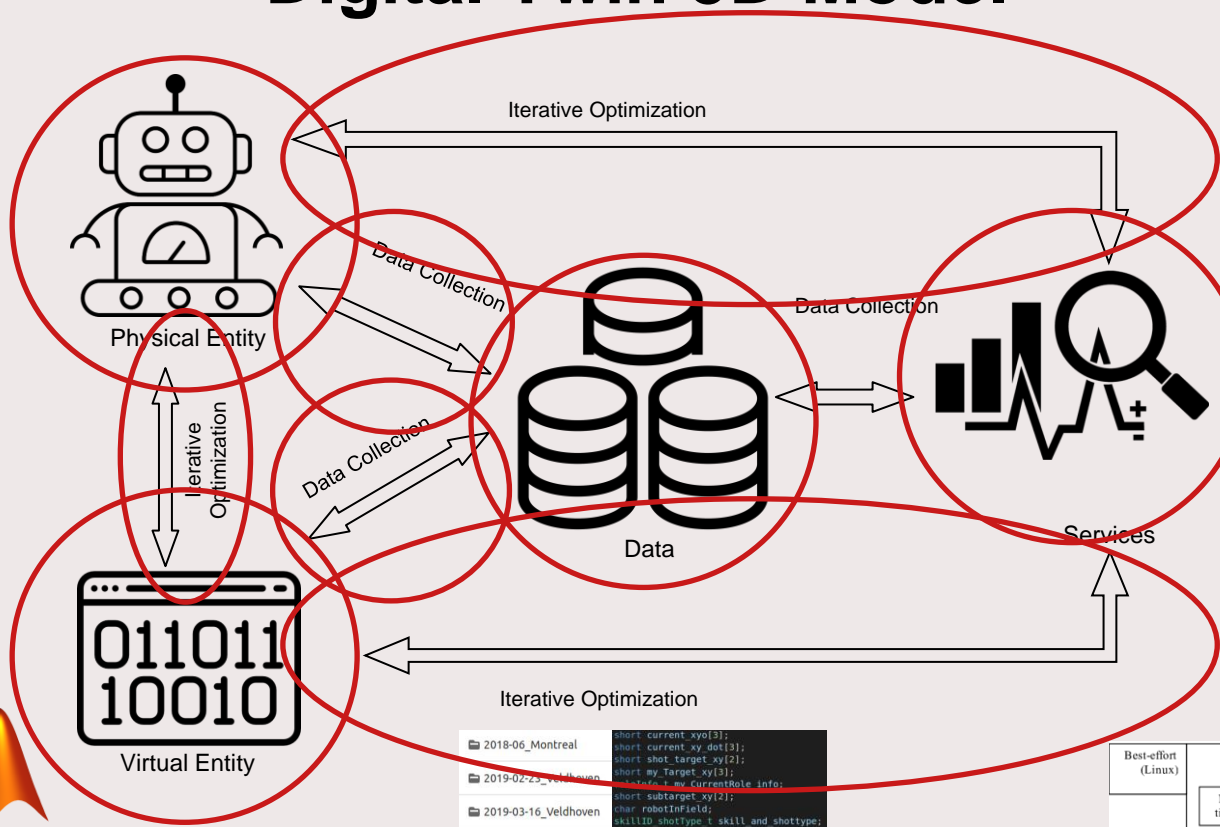
But: longstanding project

→ Can existing artifacts be used to realize DT?





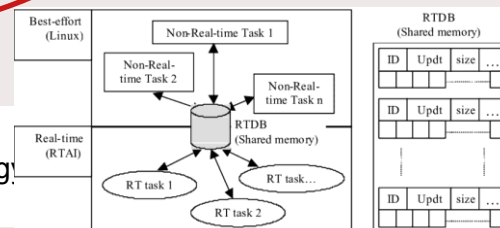
# Digital Twin 5D Model



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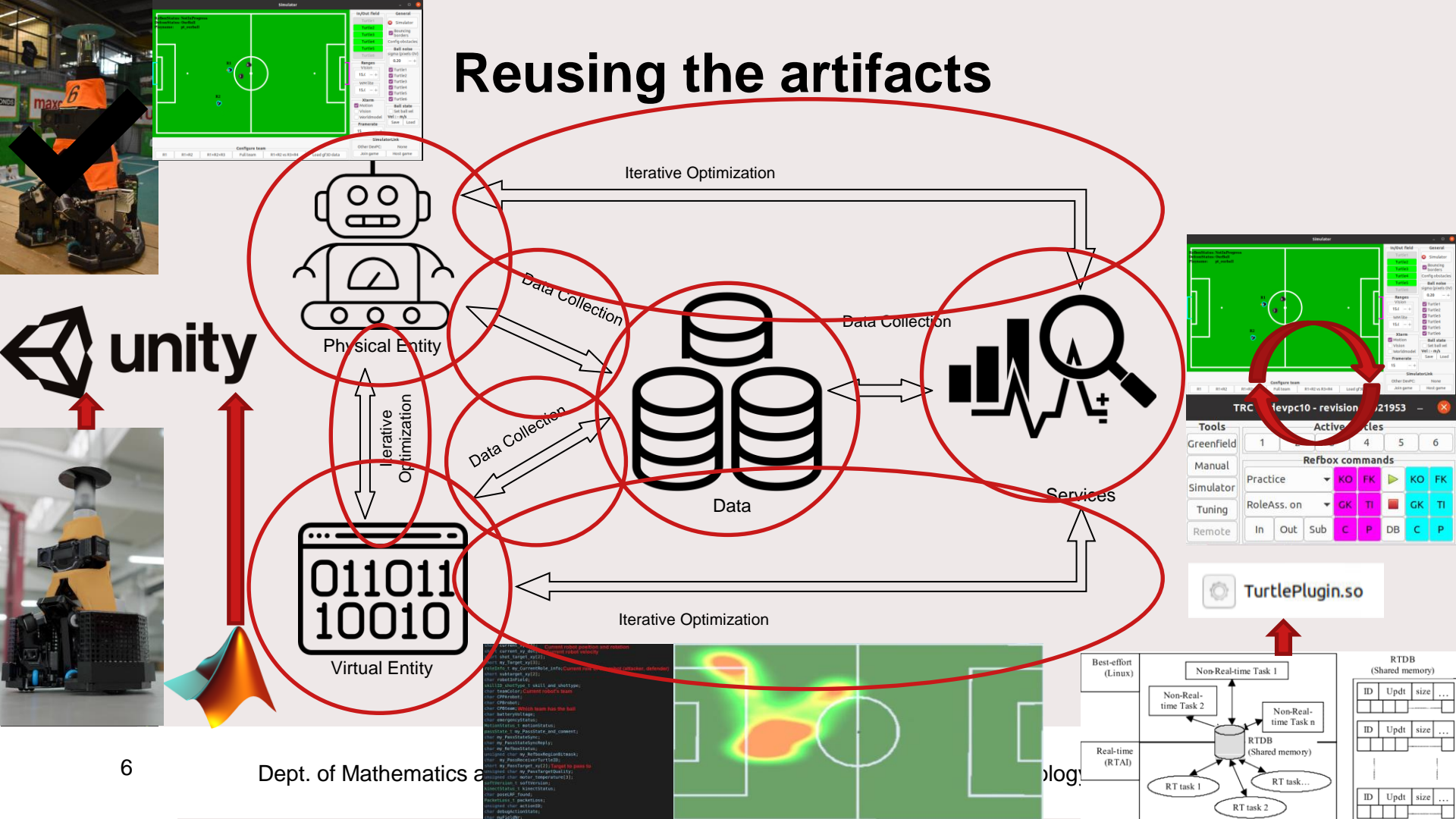
2018-06_Montreal
2019-02-25_Veldhoven
2019-03-16_Veldhoven
2019-04-06_Veldhoven
2019-06-15_Veldhoven
2019_Gondomar
2019_Sydney

short current_xy[3];
short current_xy_dot[3];
short shot_target_xy[2];
short my_Target_xy[3];
short subtarget_xy[2];
char robotInField;
skillID shotype; t skill_and_shotype;
char teamColor;
char CPARobot;
char CPBrobot;
char CPBteam;
char batteryVoltage;
char emergencyStatus;
MotionStatus t motionStatus;
passState t my_PassState_and_comment;
char my_PassStateSync;
char my_PassStateSyncReply;
char my_RefboxStatus;
    
```





# Reusing the artifacts



# Demo

# Conclusion

- Existing artifacts save time in creating DT
- Easier to maintain and use due to reuse
- Still need knowledge of subsystems and domain expertise

## Future work

This use case:

- Swap in components, test behavior
- Analyze data flow real-time
- Conduct predictive maintenance
- Troubleshoot from afar

General:

- Conduct more case studies to generalize
- Looking at artifacts: which, what phase, what purpose

